sanwa

N-501
MULTITESTER

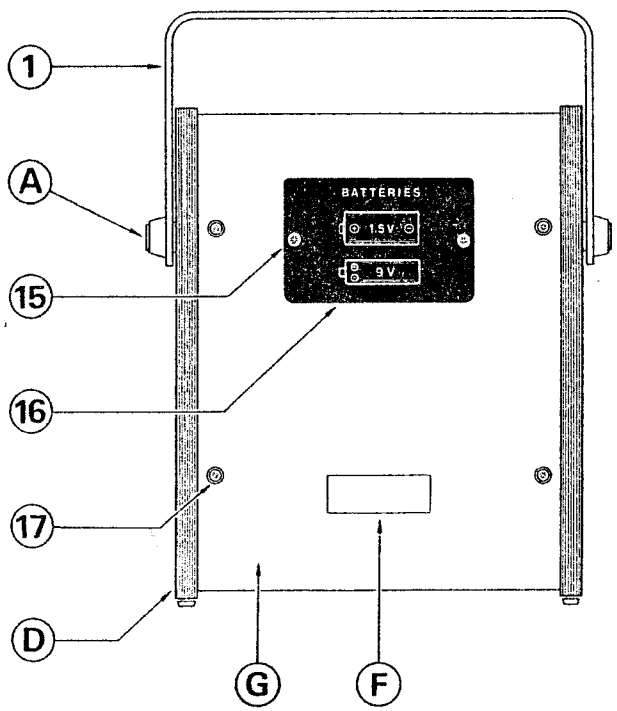
OPERATOR'S MANUAL

MAINTENANCE FOR SAFETY

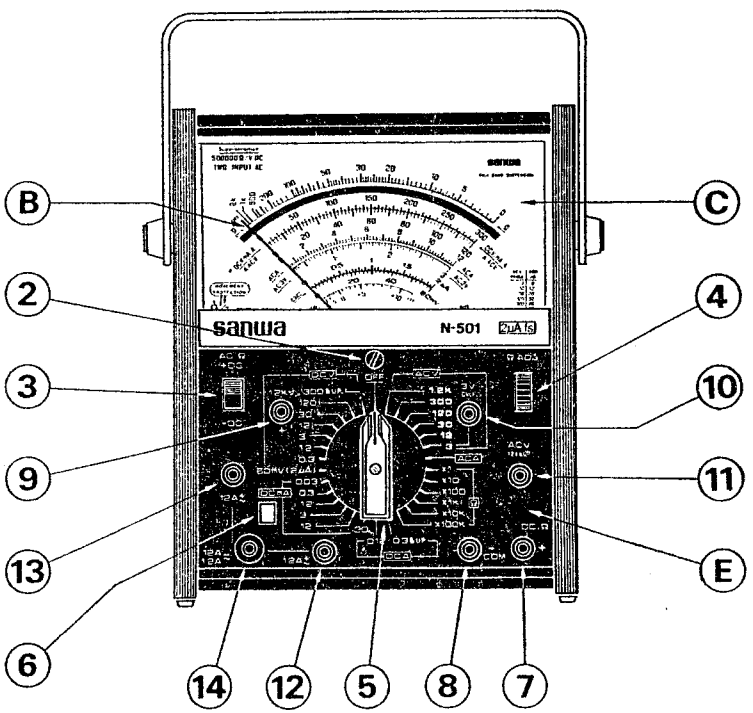
To be sure, a circuit tester is a very useful device capable of measuring voltage, current, resistance and various other electric and electronic phenomena. Hence, object of measurement it can cover ranges widely from minute current to high voltage. In addition, the input impedance across the input terminals is various: sometimes it is a few ohms, and sometimes it goes up to high megohm level as a measurement range is cut over.

These properties of a circuit tester's demand the operators to use utmost care in the operation and maintenance of the instrument to ward off danger to himself as well as damage to the device. Especially when checking high power equipment, no operation mistake should be committed. Remember a circuit tester needs periodical inspection and calibration to be maintained in good condition. An instrument laid away long unused should never be used.

On the rear case



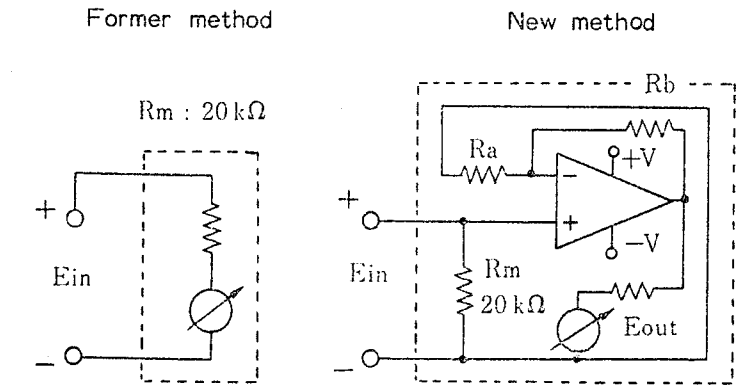
Panel arrangement



See page 10

New Type Meter Movement

1. In this instrument, mounted is a new type indicator of 2μA/40 mV developed by SANWA.
2. As indicated by the circuit diagram and the formula below an input voltage Ein is correctly transmitted as Eout basing solely on Ra and Rb.
3. The unit encircled by the dotted line in the diagram is wholly interchangeable.
   (An ultra micro power IC is contained in the indicator unit to form the Power-on-Demand Switching System.)



$$Eout = Ein \frac{Ra + Rb}{Ra}$$

INTRODUCTION

It has commonly been understood that the AC voltmeter of a circuit tester is, as it is compared with a vtvm, available only for measurement of commercial AC voltage on account of its poor frequency characteristic and insufficient input impedance. Most testers of later edition, however, use germanium diodes as rectifying element, and frequency characteristic has been tolerably improved to show expanded coverage of 20kHz～200kHz satisfying by and large the requirement for frequency response, but how about input impedance.

Average testers satisfactorily serve the purpose of checking communication circuits matched at the impedance of 600Ω. On the other, the input impedance of most amplifier circuits often comes up to 500kΩ, or more, beyond the capacity of average testers whose input impedance is somewhere about 20kΩ～50kΩ. It might be suggested to raise it to 500kΩ～1MΩ, but it would absolutely be impossible for the much too small circuit current rectified to drive the meter movement directly. There appeared on the scene is a vacuum-tube or transistor amplifier to help the tester overcome this difficulty.

In defiance to the voltmeter of a tester with a vacuum-tube or transistor amplifier equipped, here is developed by SANWA a unique circuit tester for the first time in the world. The input impedance of this tester is maintained at 1MΩ throughout its ACV range similar to that of a vtvm,

and yet the meter movement equipped is directly driven by AC voltage rectified by germanium diodes without any amplifier employed.

This splendid achievement by means of a 2uA ultrahigh sensitivity meter movement along with high impedance rectifying circuit has been accomplished, needless to say, on the responsibility assigned to SANWA, specialty manufacturers of circuit testers.

FEATURES

1 1MΩ (7pF) input impedance of AC voltmeter.

The input impedance of the AC voltmeter of average testers is not constant, but it varies as the range is moved. It is usually 6kΩ～50kΩ for their lower ranges. On the contrary, the input impedance of the AC voltmeter of N－501 is kept constant at 1MΩ for all its measurement ranges just like a vtvm. It naturally follows that the current dissipated on its 3V AC range is as small as 4uA, or so. Rectified by the efficient RF silicon diodes, it directly drives the 2uA ultrahigh sensitivity meter movement. Along with the frequency coverage extended up to 50kHz, the instrument displays maneuverability characteristic of a circuit tester and unfulfilled by a vtvm.

2 2uA full-scale taut-band meter movement.

Introduction of the 2uA ultrahigh sensitivty meter movement has realized 1MΩ input impedance for ACV measurement. On the other, minimum sensitivity resolution of 0.05uA×1mV and frictionless taut-band suspension movement have realized high accuracy measurement with least reading error.

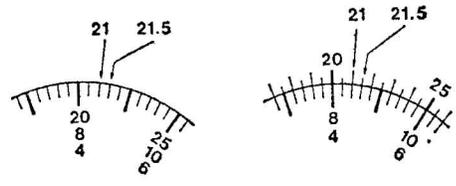
3 30-position range selector switch.

Newly designed 30-position rotary switch with extra

OFF setting readily and securely selects out the measurement range prescribed.

4 Easy-to-read scale marking.

Customarily most testers graduate a certain scale to be read in 3 ways along the single arc. In this case, as the scale is divided on an identical condition, it is difficult for a third reading to be resolved along the arc like 21 and 21.5 positions of Fig. 1. To cope with this inconvenience, here is adopted duplicate scaling system where 21 is marked by a long line and intermediary 21.5 by a short line thus making the reading along the arc by far the easier.



Convetional Revised

Fig. 1

5 Double protection device.

Ohm ×1 and current ranges are most liable to suffer burnout through misapplication. In order to protect shunts and resistors from burnout, a fuse (1A) is fitted up. In addition, silicon diodes placed in parallel with the moving coil safeguard the meter movement from burnout with the overcurrent inadvertently applied

bypassed. Doubly protected thus, the device is completely safe against damage by overload.

6 9 mm thick flank boards.

The walnut flank boards not only put the instrument steady on the bench, but they also serve to render the instrument immune from impact from side.

7 From 2uA DC up to 12A DC/AC, and 200 MΩ maximum.

From superhigh sensitivity of 2uA (60mV) up to 12A, the wide current range provided cover practically all needs of measurement, while ×100k resistance range is exceptional of a circuit tester reading 2. 6MΩ at midscale and 200MΩ at maximum driven by the internal batteries.

SPECIFICATIONS

1 Measurement ranges.

DCV	(±) 60m 0.3 1.2 3 12 30 (500kΩ/V) 120 300 1.2k (50kΩ/V) 30kV w/HV probe
ACV	3 12 30 120 300 1.2k (0.7MΩ～1MΩ—7pF) Frequency - 20Hz～50kHz (±1dB)
DCA	(±) 2u (60mV drop) 0.03m 0.3m 1.2m 3m 12m 30m 0.12 0.3 1.2 12 (300mV drop)
ACA	1.2 12 (300mV drop)
Ω	Range - ×1 ×10 ×100 ×1k ×10k ×100k Midscale - 26 260 2.6k 26k 260k 2.6M Maximum - 2k 20k 200k 2M 20M 200M Batteries - 1.5V × 1 & 9V × 1
dB	−20～+11 for 3V AC up to +63

2 Accuracy.

Within ±2% fs for DC ranges
Within ±2.5% fs for AC ranges
Within ±2% of arc for Ω ranges

Dimensions : 252 × 191 × 107mm
Weight : 2kg approx.

ON THE FRONT PANEL AND THE REAR COVER

-Functions of control gears (See inside front cover)

① Bali handle.

Rigid carrying handle of 3mm thick when pushed down positions the instrument at a convenient viewing angle.

② Pointer 0 corrector.

Though the instrument is preferably used in a level or near-level position, it may sometimes be required to be set upright. Position of the instrument often renders the pointer unbalanced reading off 0. It is rectified by the 0 corrector.

③ Polarity reversal switch.

For DC measurement, the polarity switch readily reverses the polarity of the input terminals according to that of the load being checked doing away with the trouble of inverting the connections of the test leads allowing the negative test lead kept connected to the ground. Polarity switch is now an indispensable gear for checking FM discriminator and transistor circuits.

④ 0Ω adjuster.

Resistance measurement requires 0Ω position of the

pointer to be adjusted each time the range is moved. 0Ω adjuster is one of the most useful devices of a tester, because it also checks and suggests the internal batteries to have worn out needing replacement.

The pointer is adjusted to 0Ω by shorting together the test leads connected to + and − terminals. As the pointer moves up towards right, 0Ω adjuster is turned to the right or left to place the pointer exactly on 0 of the Ω scale on the top.

⑤ Range selector switch knob.

The range prescribed is selected by rotating the knob in either direction. The large-size color knob distinctly indicates correct switch setting.

⑥ Neon lamp.

The fuse fitted blows when there is overload misapplied across + and −COM terminals, and the neon lamp is lighted. As they are released of overload, it goes out.

⑦⑧ Terminals for DC measurement - DC·Ω/+ and −COM.

These terminals are used for all DC measurements including voltage, current and resistance. The red lead is connected to + and the black lead to −COM terminals except for 1.2kV, 1.2A and 12A. They are also used for connecting HV probe when checking TV circuits.

⑨ **Exclusive jack for 1.2kV DC - 1.2kV+.**

For 1.2kV, the red lead uses this jack exclusively with the black lead going to −COM jack.

⑩ **Exclusive jack for 3V AC - 3V ONLY.**

For 3V AC, this jack is used exclusively along with −COM jack.

⑪ **ACV jack - 12V & UP.**

This jack is used for all ACV measurements along with −COM jack except for 3V which uses exclusive jack.

⑫⑭ **Exclusive 1.2A jacks - 1.2A ⎓ and 1.2A≂.**

These jacks are used for 1.2A DC and AC. No fuse across these terminals.

⑬⑭ **Exclusive 12A jacks - 12A⎓ and 12A≂.**

These jacks are used exclusively for 12A DC and AC. No fuse across these terminals.

⑮ **Bolts for battery cover plate.**

These bolts are removed when batteries are replaced.

⑯ **Battery cover.**

Positions of the batteries in the battery case are indicated inside.

⑰ **Rear cover bolts.**

4 corner bolts are removed when replacing the fuse

blown.

Ⓐ **Bail handle clamp** (BS resin).

Ⓑ **Pointer.**

Ⓒ **Indicator protection cover** (metacrylic).

Ⓓ **Flank boards** (9mm-thick walnut partly matted).

Ⓔ **Control panel** (2-color half-toner, phenol resin).

Ⓕ **Serial number.**

Ⓖ **Rear cover** (phenol resin).

OPERATION

1 Scale 0 correction.

Before operating the instrument, confirm the position of the pointer to be on 0 of the scale left. If it is found off, 0 corrector ② is adjusted to place it exactly on 0.

2 Test lead connections.

The plugs of the red and the black test leads attached are inserted into the jacks being used. Insert them well down as shown in Fig. 2-A. The jacks fitted to SANWA testers are so contrived as to hold the the test lead plugs securely. They do not come off by a force corresponding to less than 1kg. For safety, metal plugs can completely be buried in. Fig. 2-B shows faulty connection which not only reduces structural merit, but sometimes involves danger. For measurement use the test leads attached. Connection effect is lost by using test leads of other size.

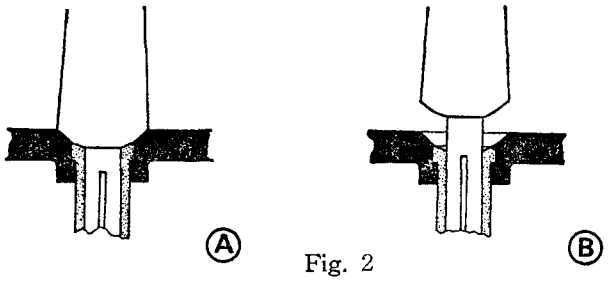


Fig. 2

3 Measuring ±DCV - 60mV ~ 1.2 kV.

3-1 Polarity switch is set either to +DC or −DC depending on the polarty of the voltage being measured. For 300V and under, use + and −COM jacks, and up to 1.2kV, exclusive 1.2kV(+) jack is used for red lead connection.

3-2 DCV is measured in 9 ranges from 60mV (0.06V) to 1.2kV. For the input impedance and the scale to be used for each range, refer to the following table:

Switch position	Full-scale reading	Input impedance	Scale to read	Multiplier
60mV (2uA)	60mV	30kΩ	DC 0-60mV	1
0.3	0.3V(300mV)	150kΩ	DCV 0-300	0.01 in V 1 in mV
1.2	1.2V	600kΩ	〃 0-120	0.01 in V
3	3V	1.5MΩ	〃 0-300	0.01 in V
12	12V	6MΩ	〃 0-120	0.1 in V
30	30V	15MΩ	〃 0-300	0.1 in V
120	120V	6MΩ	〃 0-120	1 in V
300 & UP	300V	15MΩ	〃 0-300	1 in V
300 & UP	1.2V (1200V)	60MΩ	〃 0-120	0.01 in kV 10 in V

3-3 What 2uA (500kΩ/V) DC voltmeter signifies.

For DCV measurement, the current the instrument dissipates is so minute as 2uA full scale. In other words, no extra energy is absorbed from the circuit being measured reading as effectively as by a vtvm. The following table compares various testers with N-501 in measuring

DC Voltage of a high impedance circuit. In Fig. 3. true DCV at point P should read 10V.

Tester used	Reading	Error
N-501 on DC 12V range	9.89V	−1.1 %
100kΩ/V tester on DC 12V range	9.5V	−5 %
20kΩ/V tester on DC 10V range	7.5V	−25 %
Average tester	3.73V	−63 %

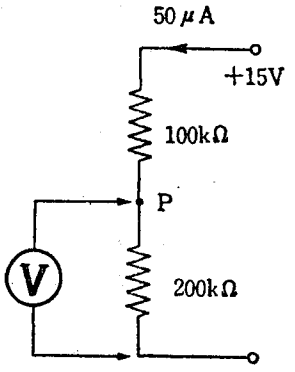


Fig. 3

DC amplifier, AVC, AGC voltages, transistor bias circuit, etc. are usually measured by a vtvm. Now N-501 multitester is capable of making these measurements showing by far the better results than by a conventional tester.

3-4 Function of polaity switch.

Polarity switch reverses the polarity of the input terminals without the connections of the test leads inverted. It allows the negative test lead left connected to the ground for DCV measurement of FM discriminator and transistor circuits in their correct polarity.

3-5 Transistor test.

The DCV range of a tester effectively tests and judges the quality of in-circuit trsnsistors by

checking the voltage drop across base and emitter. It also tells a silicon from a germanium transistor by the voltage read across base and emitter. Normally it should read as follows:

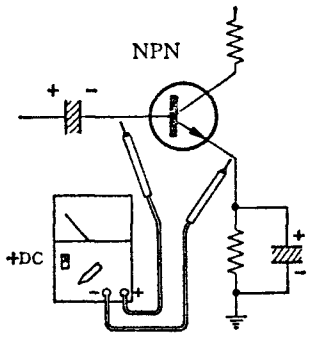


Fig. 4

0.1V~0.3V (low) for germanium transistors

0.5V~1V (high) for silicon transistors

If a habit is formed to test a transistor by applying positive lead to base and negative lead to emitter (Fig. 4), the position of the polarity switch readily determines if it is a pnp or npn transistor.

Polarity switch at +DC·····npn
〃 〃 〃 −DC·····pnp

3-6 HV probe for checking TV circuit.

TV circuit high voltage is measured by means of the HV probe available extra. Fig. 5 shows the connections, where the range switch is placed at DCmA 0.03. The HV probe measures 30kV

at maximum to be read in kV on DCV 0-300 arc multiplied by 0.1. HV probe should not be used for measurement of other than the high voltage of a high impedance TV circuit.

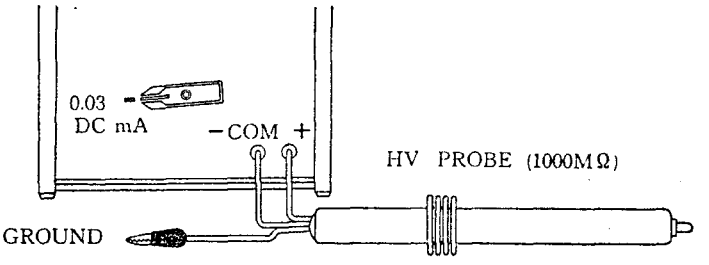


Fig. 5

4 Measuring ACV - 3V～1.2kV.

4-1 For 3V, use the exclusive jack marked '3V ONLY' along with −COM jack. For 12V and above, ACV 12V&UP and −COM jacks are used. Polarity switch is set to DC as indicated.

4-2 The rectifier circuit for ACV measurement of this instrument is, as shown in Fig. 6 (A), composed of a high resistance (1MΩ) and a capacitor (0.05uF) in series to block DC current. It is fundamentally different from the rectifier circuit of a usual tester in which input impedance varies as a range is moved. By virtue of the big and at the same time constant input impedance, N-501 affords performance similar to a vtvm.

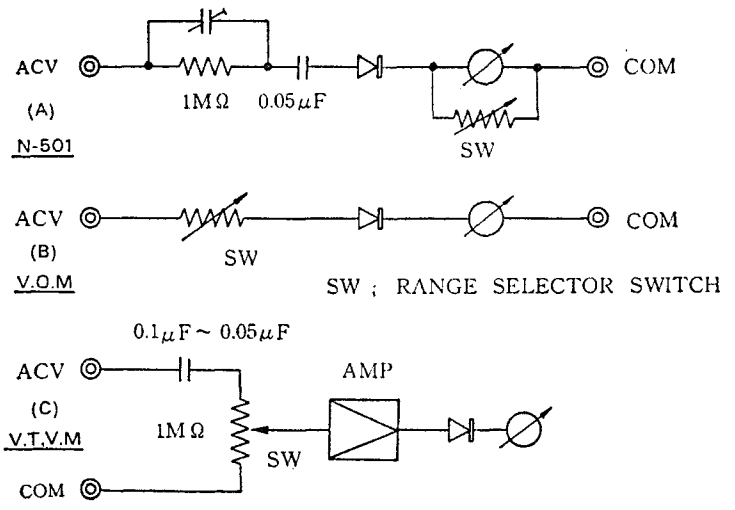
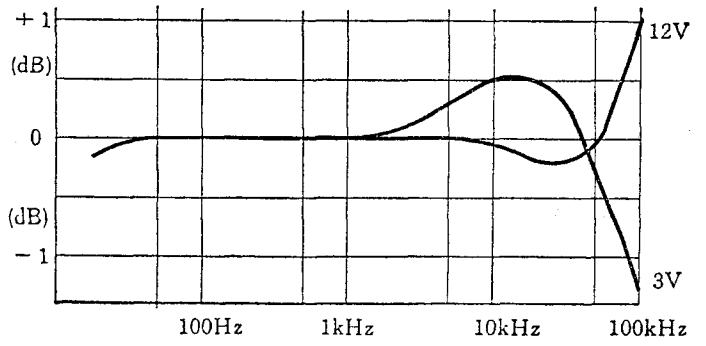


Fig. 6

4-3 Frequency characteristic.



FREQUENCY RESPONSE

Fig. 7

4-4 ACV is measured in 6 ranges, 3V~1.2kV, of which the tester range and scale reading are related as follows:

Switch position	Full-scale reading	Scale to use	Multiplier
3	3V	AC 3V 0-3	1
12	12V	ACV 0-120	0.1 in V
30	30V	〃 0-300	0.1 in V
120	120V	〃 0-120	1 in V
300	300V	〃 0-300	1 in V
1.2k	1.2kV (1200V)	〃 0-120	0.01 in kV 10 in V

Input impedance - Abt. 0.7 MΩ~1 MΩ (1kHz)

Note. Inherent capacitance across input terminals is abt. 7pF for both 3V and 12V&UP.

Parallel capacitance across input terminals is harmful to accuracy measurement. It is so small as 7pF for N-501 as compared with 25pF of a vtvm for tester. This is because the input terminals of this instrument are independent. This marked difference affords the instrument so much the more accuracy reading.

4-5 0.05uF series capacitor interconnected.

The AC measurement circuit has 0.05uF capacitor interconnected to block DC element eliminating the trouble of replugging the test lead into a separate jack as necessity occasions. Thus the instrument always detects AC signal alone to read it in mean value ratio.

5 Measuring AF output level (dB).

5-1 Switch positions for ACV measurement also check AF output level by reading instead of the ACV scale the dB scale corresponding to the range used. For 3V range, it is directly read on the scale provided, but for 12V and above, dB is obtained by adding to the reading on the scale the value given in the ADD dB table on the corner of the scale dial according to the range used.

5-2 The dB scale of the instrument is based on a voltage when 1mV is dissipated across a 600Ω line, which is approximately 0.775V, and the dB measured for a 600Ω transmission circuit is in itself the output power dB. See Note below. The input impedance of 1MΩ of the instrument is by far the higher than the line impedance, and measurement loss can be ignored.

Note. When voltage ratio is 10, $dB = 2 \times 10 \log_{10} = 20$ dB. If the voltage ratio is 10 against one and the same load, power ratio will be: $10^2 = 100$. Therefore, power ratio dB is:

$$10 \log_{10} 10^2 = 2 \times 10 \log_{10} = 20 \text{dB}$$

In other words, absolute dB values for power and voltage ratios are identical for the same load.

5-3 For a general amplifier like the one shown in Fig. 8, the input impedance (Z_1) and the output impedance (Z_2) are not necessarily 600Ω, nor they are standardized. When measuring such a

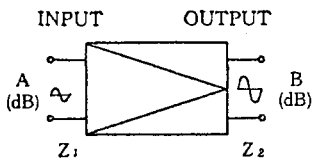


Fig. 8

circuit, the dB read by a tester, or by a vtvm, is no more related with power ratio, but it is nothing but a dB value denoting the ratio of the voltage at 0dB (0.775V) to the voltage it is measured at. For instance, in Fig. 8, voltage gain of the amp lifier is (B–A) dB. Unless difference is figured out thus, the values obtained make no sense at all.

5–4 Line impedance other than 600Ω. For a line impedadce other than 600Ω, true dB is obtained by adding the dB given in the following table to the reading according to the circuit impedance checked:

Z (Ω)	Add dB
2k	−5.2
1k	−2.2
600	0
500	+0.8
300	+3.0
200	+4.8

Z (Ω)	Add dB
150	+ 6.0
75	+ 9.0
50	+10.8
16	+15.8
8	+18.8
4	+21.8

5–5 Measurement of output power (W).

$$\text{Output power (W)} = \frac{(\text{Votage measured})^2}{\text{Impedance}}$$

Providing the tester reads 4V on 12V AC range for 8Ω line impedance:

$$W=\frac{4^2}{8}=\ 2\,(W)\quad \text{See graph.}$$

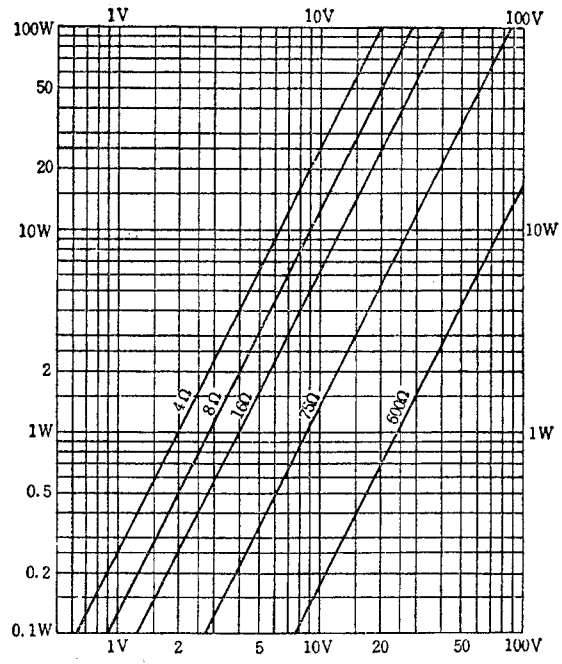


Fig. 9

6 Measuring high voltage - 300V and above.

When measuring high power voltage circuits, strictly observe the following instructions:

6-1 Before connecting the tester to the circuit, be sure to switch off power and the smoothing capacitor in the circuit discharged.

6-2 Reconfirm if the position of the range switch and the connections of the test leads are correct.

6-3 Power is now switched on, and the meter reading is noted, but never touch with the hand any part of the tester, test leads, nor the circuit under test.

6-4 Measurement over, power is switched off, but do not remove the connections before the pointer is ascertained to have returned to 0.

6-5 High impedance circuits of television and communication equipment can be measured in usual manner providing their circuit current is not big.

7 Measuring Ω.

7-1 Polarity switch is placed at +DC.

7-2 0Ω adjustment.

Before taking a measurement, the test leads connected to the tester are shorted together, and as the pointer moves towards 0 of the Ω scale, 0ΩADJ ④ is adjusted to place it exactly on 0 of the scale right.

7-3 Resistance is measured in 6 ranges from ×1 to ×100k. Midscale reading, current dissipation etc. are related as follows:

Switch position	Minimum reading	Midscale reading	Maximum reading	Current consumption	Maximu m voltage loaded
×1	0.5Ω	26Ω	2kΩ	60mA	1.5V
×10	5Ω	260Ω	20kΩ	6mA	〃
×100	50Ω	2.6kΩ	200kΩ	600uA	〃
×1k	500Ω	26kΩ	2MΩ	60uA	〃
×10k	5kΩ	260kΩ	20MΩ	6uA	〃
×100k	50kΩ	2.6MΩ	200MΩ	4uA	9V

7-4 Polarity for resistance measurement.

As the schematic diagram shows, the polarity of the input terminals is reversed for resistance measurement, + jack being in minus and — jack in plus potential. It must be remembered when checking the leakage and insulation of electrolytic capacitors and polarized resistance of semiconductors like transistors and diodes.

7-5 Replacement of batteries.

0Ω adjustment is impossible when the internal batteries have worn out. Batteries wasted should be immediately replaced. For replacement, remove the battery cover on the rear. If 0Ω adjustment is impossible for ×100k range alone, 9V battery (006P) is replaced.

8 Measuring DC uA, mA and A.

8-1 Voltage is measured by applying the test leads in parallel with load, while current is measured

by connecting the instrument in series with it opening the circuit being checked.

8-2 Polarity switch is placed at +DC or −DC subject to the polarity of the current being measured.

8-3 DC current is measured in as many as 11 ranges from minute 2uA up to big 12A. Switch settings, scales to be used, etc. are related as follows:

Switch position	Full-scale reading	Voltage drop	Scale to use	Multiplier
2uA(600mV)	2uA	60mV	0-2 (uA) fs	1
0.03	30uA (0.03mA)	300mV	DCmA 0-300	0.1 in uA
0.3	300uA (0.3mA)	〃	〃 0-300	1 in uA
1.2	1.2mA	〃	〃 0-120	0.01 in mA
3	3mA	〃	〃 0-300	0.01 in mA
12	12mA	〃	〃 0-120	0.1 in mA
30	30mA	〃	〃 0-300	0.1 in mA
0.12	120mA(0.12A)	〃	〃 0-120	1 in mA
0.3 & UP	300mA(0.3A)	〃	〃 0-300	1 in mA
0.3 & UP	1.2A	〃	DCA 0-120	0.01 in mA
0.3 & UP	12A	〃	〃 0-120	0.1 in mA

The wide range of measurement covers practically all needs of current measurement from galvanometer to power circuit. Especially when the majority of electronic equipment is now composed of IC blocks, it is considered to be a decisive factor to diagnose these circuits by checking their current dissipation. It is another big advantage of N-501 that it is provided with such

wide current range as could not be desired of a vtvm.

9 Measuring ACA - 1.2A and 12A.

9-1 Range switch is set to ACA.

9-2 1.2A and 12A jacks for DCA measurement are used in common for ACA measurement.

9-3 Polarity switch is placed at +DC same as for ACV measurement.

9-4 Current being measured, the tester is connected in series with load as for DCA measurement.

9-5 Exclusive ACA scale (red) is used reading 0-12 line directly for 12A and multiplied by 0.1 for 1.2A.

9-6 1.2A and 12A ranges use common shunts for DCA and ACA allowing the same jacks to be used for test lead connections. This is one of the notable features of the instrument under the obligation of a tester to use a moving-coil type indicator in the limited space. N-501 is so designed as will perform as effectively as a moving-iron type device, and this outstanding feature affords the shunts for enlarging DCA range to be used just as they are for enlarging ACA range also.

As AC amperemeter the instrument is available not only for checking various home appliances, but for inspecting, experimenting in and adjusting

AC current consumption of power equipment as well.

10 Replacement of the fuse blown.

10-1 Burnout is the damage a tester most frequently suffers caused by AC voltage above 100V misapplied to a current range (0.3A/input impedance 1Ω) or Ω-×1 range (input impedance 26Ω). In order to arrest burnout damage the instrument has a fuse (1A) fitted which blows the moment there is overload inadvertently applied to it.

10-2 When the fuse is blown, the neon lamp on the lower left corner of the control panel is lighted.

10-3 The instant the fuse is blown, the instrument ceases to function.

10-4 To replace the fuse blown, remove the rear cover and fit up the spare fuse in place. Use the fuse on the back of the indicator.

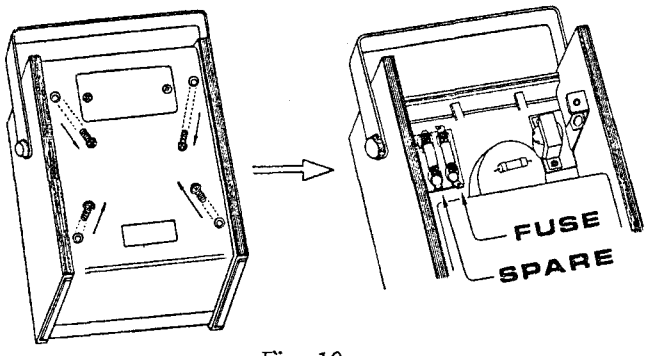


Fig. 10

10-5 Always stock a spare on the fuse holder providing for imminent use. 2 spare fuses are supplied besides the one fitted inside.

10-6 As the fuse is replaced and the rear cover put back, just check the movement of the pointer on an Ω range to ascertain normal performance.

MAINTENANCE

1 Measurement of unknown voltage.

If it is a power voltage, measure it with utmost care observing the instructions given in 6 for high voltage measurement. When checking communication equipment, make it a habit to start with the highest range to know the approximate value present. After the first reading, the switch can be reset to a lower range for a more accurate reading.

2 High temperature and moisture.

A tester is a precision measuring device of delicate nature, and be careful not to leave it long where there is high temperature or moisture. When it is kept long unused, batteries had better be removed from it because electrolyte might leak to corrode the internal components.

3 Indicator cover.

Do not rub hard the surface of the indicator cover because it is of metacrylic resin and treated with anti-electrification coating. Metacryl is softer than glass and is liable to get scraped. Coating effect may be lost by use, when as a temporary measure it can be sprayed with disc cleaner.

4 Taut-band versus pivot suspension.

2uA sensitivity has necessitated the instrument to be

equipped with a taut-band suspension meter movement for increased accuracy. As regards merit and demerit of this type of movement as compared with a usual pivot suspension movement, refer to the following comparison table:

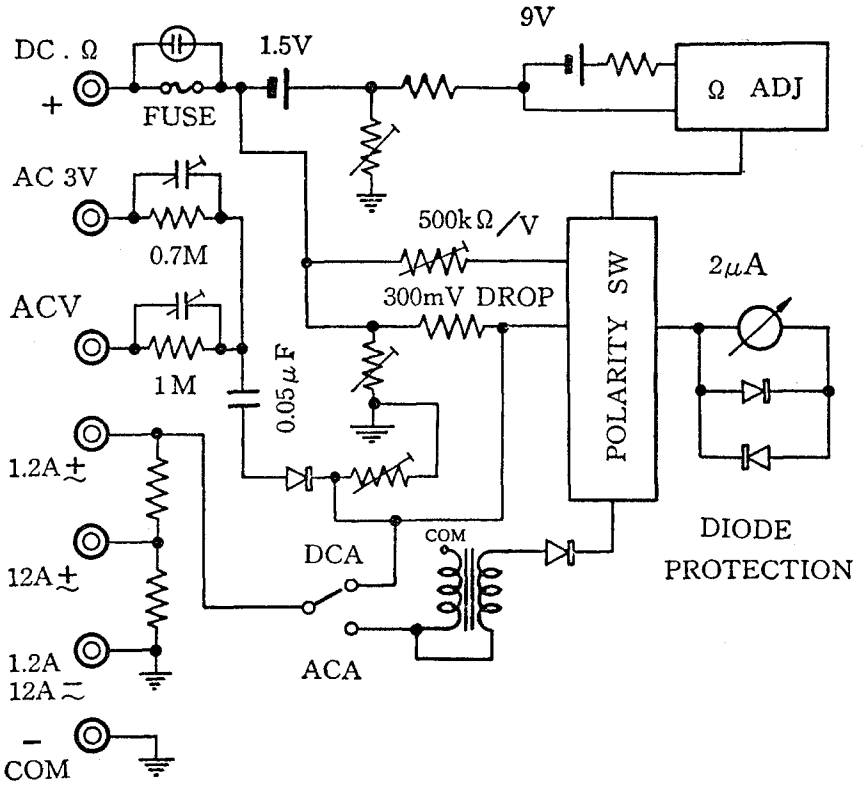
Suspension	Merit	Demerit
Pivot	Contact suspension stabilizes pointer to obtain good balance.	Friction causes reading error. Unsuitable for movement above 10uA.
Taut-band	No contact friction and shockproof. No hysteresis error.	Hard to take balance of pointer for large-size movement. Error by position liable (level or upright).

5 Inherent breakdown and the fuse.

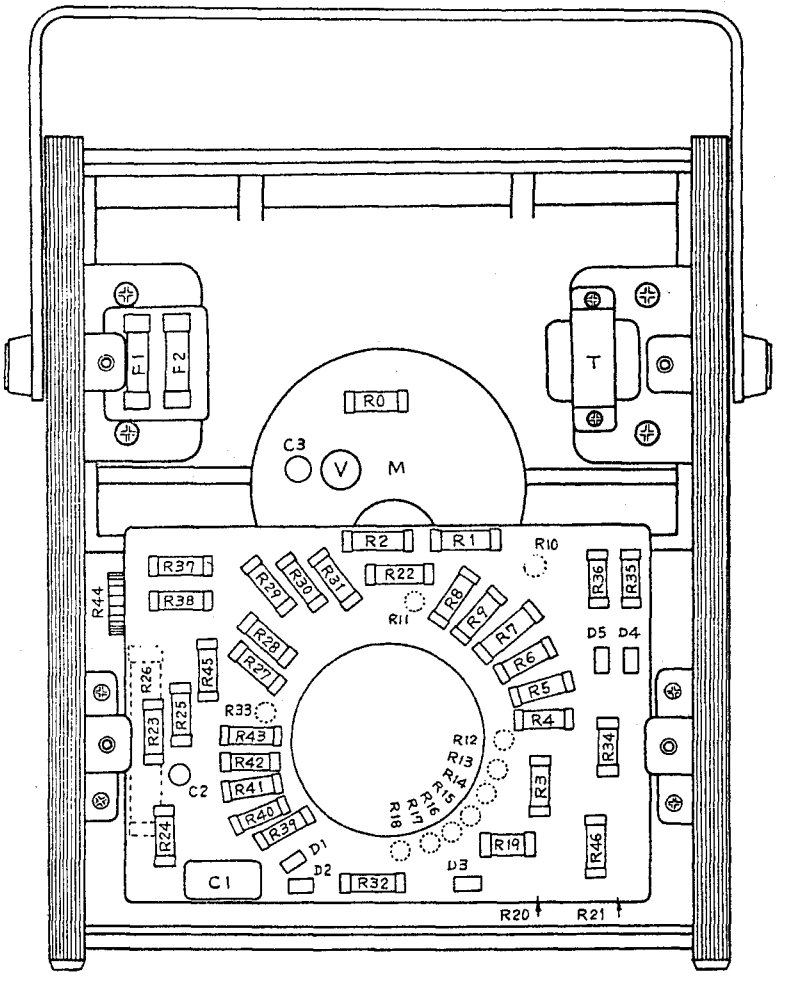
The intrument completely ceases to perform when, (1) the moving coil becomes open-circuit, or (2) the fuse is blown. If it is put to use unaware of the fuse blown, ceased operation might be attributed to the moving coil becoming open, and the instrument be sent out for repairs. Before it is, locate the cause of the trouble. Open-circuit of a test lead can also render the instrument dead.

SUPPLEMENTARY DATA

1 Block diagram.



2 Arrangement of parts (rear view).



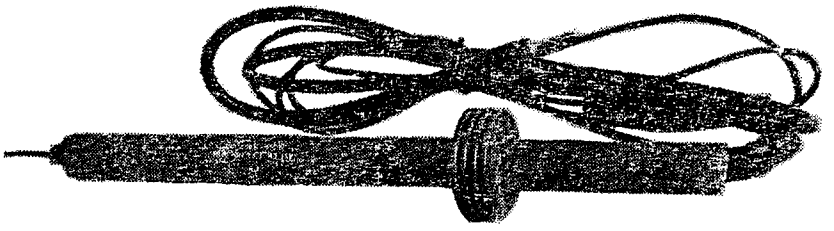
3 List of parts.

Part No.	Description	R. S.
N5R00	Resistor (10~15kΩ) for mV calibration	R0
N5R01	Resistor (10kΩ) series	R1
N5R02	Resistor (30kΩ) series	R2
N5R03	Resistor (90kΩ) 0.3V DC multiplier	R3
N5R04	Resistor (450kΩ) 1.2V DC multiplier	R4
N5R05	Resistor (900kΩ) 3V DC multiplier	R5
N5R06	Resistor (4.5MΩ) 12V DC multiplier	R6
N5R07	Resistor (9MΩ) 30V DC multiplier	R7
N5R08	Resistor (135kΩ) series	R8
N5R09	Resistor (135kΩ) series	R9
N5R10	Resistor (45MΩ) 1.2kV DC multiplier	R10
N5R11	Resistor (16.6kΩ) shunt	R11
N5R12	Resistor (10.7kΩ) 0.03mA DC shunt	R12
N5R13	Resistor (1.01kΩ) 0.3mA DC shunt	R13
N5R14	Resistor (250Ω) 1.2mA DC shunt	R14
N5R15	Resistor (100Ω) 3mA DC shunt	R15
N5R16	Resistor (25Ω) 12mA DC shunt	R16
N5R17	Resistor (10Ω) 30mA DC shunt	R17
N5R18	Resistor (2.5Ω) 0.12A DC shunt	R18
N5R19	Resistor (0.75Ω) 0.3A DC shunt	R19
N5R20	Resistor (0.225Ω) 1.2A DC . AC shunt	R20
N5R21	Resistor (0.025Ω) 12A DC . AC shunt	R21
N5R22	Resistor (150kΩ) series	R22
N5R23	Resistor (225kΩ) 3V AC series	R23
N5R24	Resistor (200kΩ) 3V AC series	R24
N5R25	Resistor (550kΩ) series	R25
N5R26	Resistor (1MΩ) ACV series	R26
N5R27	Resistor (240kΩ) 12V AC	R27
N5R28	Resistor (57kΩ) 30V AC	R28
N5R29	Resistor (11.7kΩ) 120V AC	R29
N5R30	Resistor (4.55kΩ) 300V AC	R30
N5R31	Resistor (1.12kΩ) 1.2kV AC	R31
N5R32	Resistor (900kΩ) shunt	R32
N5R33	Resistor (30kΩ) shunt	R33
N5R34	Resistor (18kΩ) ACA series	R34
N5R35	Resistor (20kΩ) for rectifier circuit	R35
N5R36	Resistor (20kΩ) for rectifier circuit	R36
N5R37	Resistor (2.5MΩ) Ω-×100k series	R37
N5R38	Resistor (270kΩ) series	R38

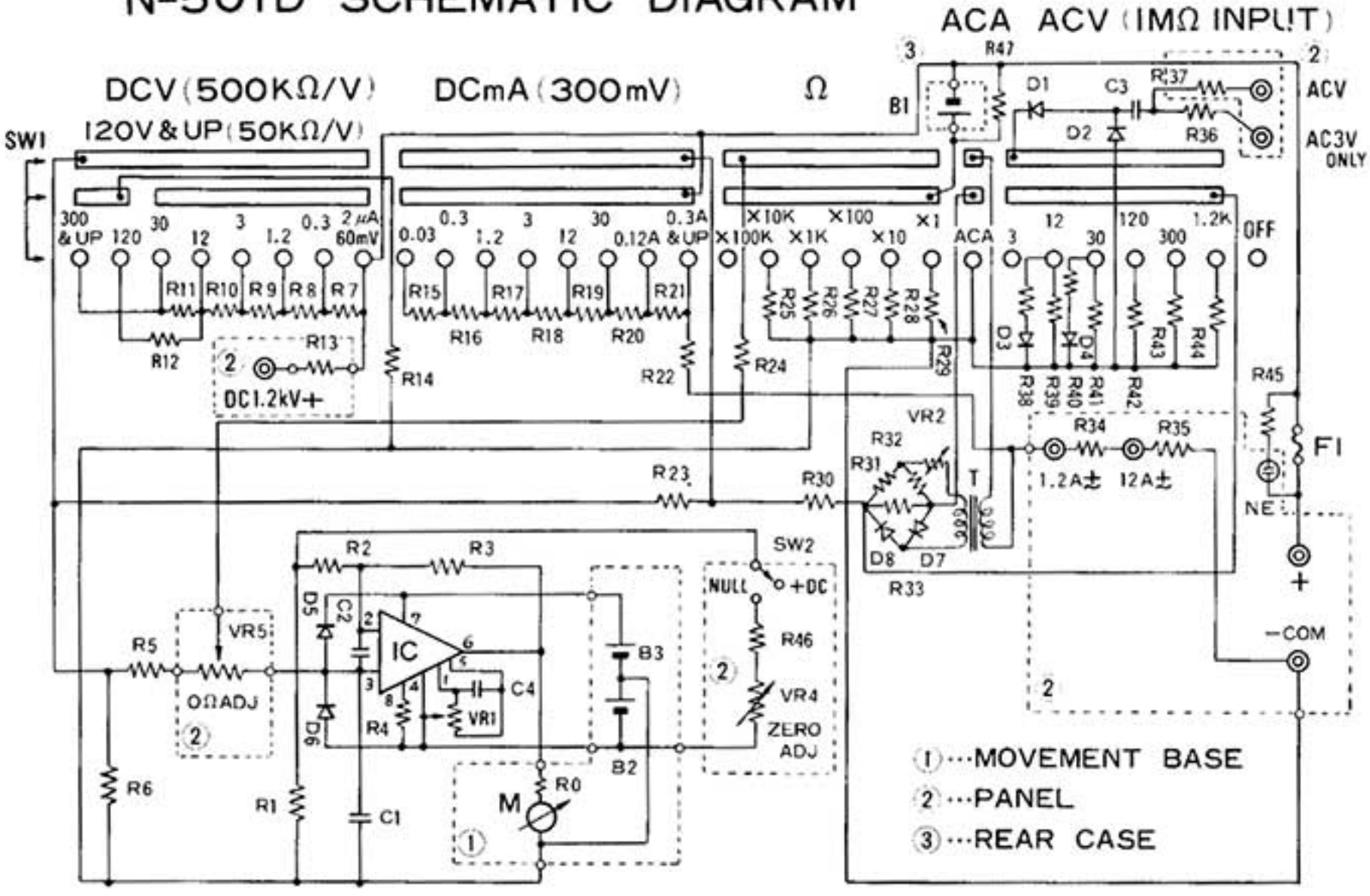
Part No.	Description	R. S.
N5R39	Resistor (870kΩ) Ω-×10k shunt	R39
N5R40	Resistor (28.2kΩ) Ω-×1k shunt	R40
N5R41	Resistor (2.63kΩ) Ω×100 shunt	R41
N5R42	Resistor (260Ω) Ω-×10 shunt	R42
N5R43	Resistor (26Ω) Ω-×1 shunt	R43
N5R44	Potentiometer (200kΩ) for 0Ω adjustment	R44
N5R45	Resistor (140kΩ) shunt	R45
N5R46	Resistor (450kΩ) neon lamp series	R46
FR07	Silicon diode	D1-D2
FR06	Silicon diode	D3
FR05	Germanium diode	D4-D5
B002	Drycell (1.5V, UM-2)	B1
B005	Drycell (9V, 006P)	B2
TR03	Transformer	T
M017	Meter movement (2uA, taut-band type)	M
V001	Varister for meter movement protection	V
C052	Capacitor (0.05uF)	C1
C051	Capacitor (15pF)	C2
C050	Capacitor (0.05uF)	C3
F001	Fuse (1A) w/holder	F1-F2
NE01	Neon lamp w/holder	NE
N5SW1	Rotary switch w/resistor holder	
N5P01	Front panel (N-501 type)	
X018	Rear case (N-501 type)	
N5T01	Terminal for UM-2 drycell, 2 required	
N5T02	Studded terminal for 006P drycell	
N5BC1	Battery case cover	
T002	Terminal jack, 8 required	
K013	Knob for rotary switch	
PSW1	Polarity reversal switch	
C019	Meter movement cover	
BA02	Meter movement base	
S007	Flank board w/holding metal, 2 required	
H002	Bail handle w/2 fixing bolts	
L001	Test lead, pair	
V003	Rear case bolt, 4 required	

R. S. Reference symbol

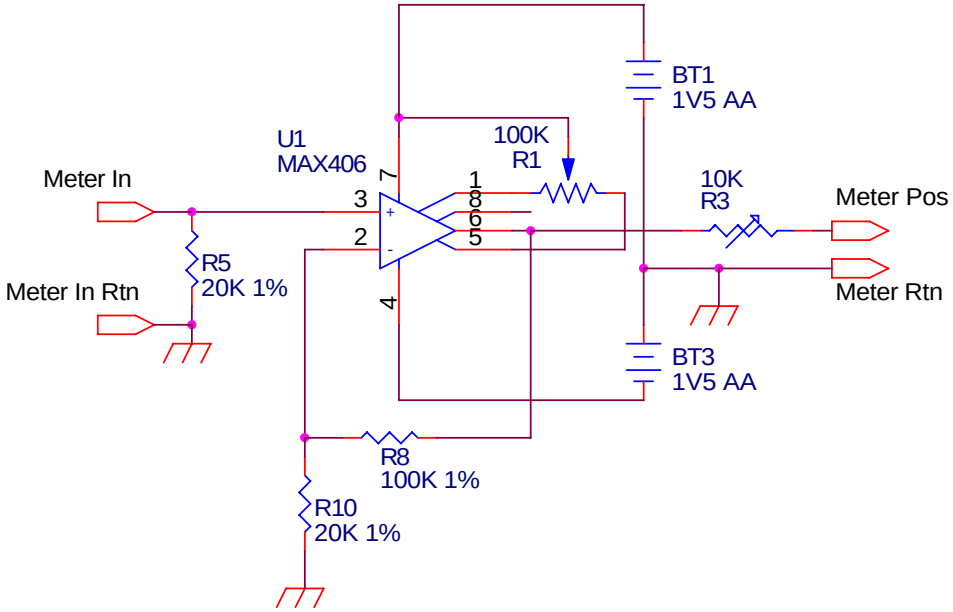
◇ **30kV HV probe available extra**



N-501D SCHEMATIC DIAGRAM

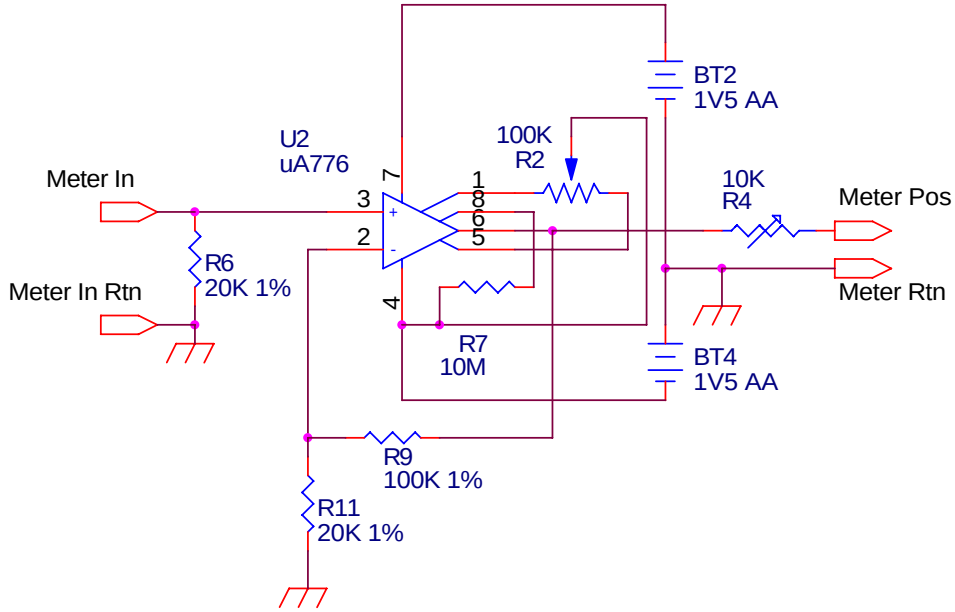


sanwa
SANWA ELECTRIC
INSTRUMENT CO., LTD.
Dempa Bldg., Sotokanda 2-Chome
Chiyoda-Ku, Tokyo, Japan



Modified Circuit:

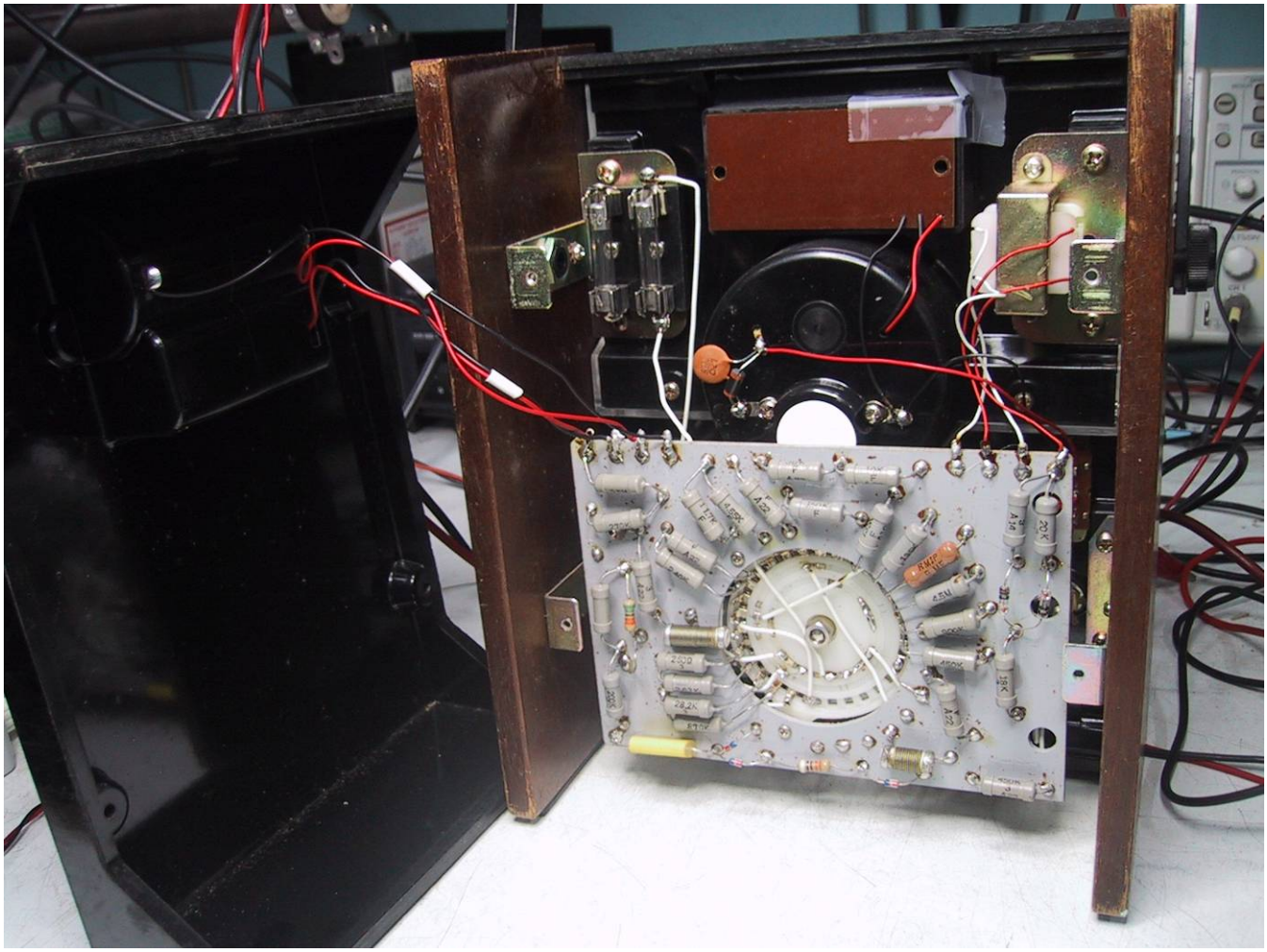
MAX406 Replaced Obsolete uA776
Null Potentiometer connection different
Bias current programming resistor R7 not required
Pin 8 bandwidth control left open
BT1 and BT3 now accessible and replaceable
Adjust R1 for meter zero
Adjust R3 for FSD calibration



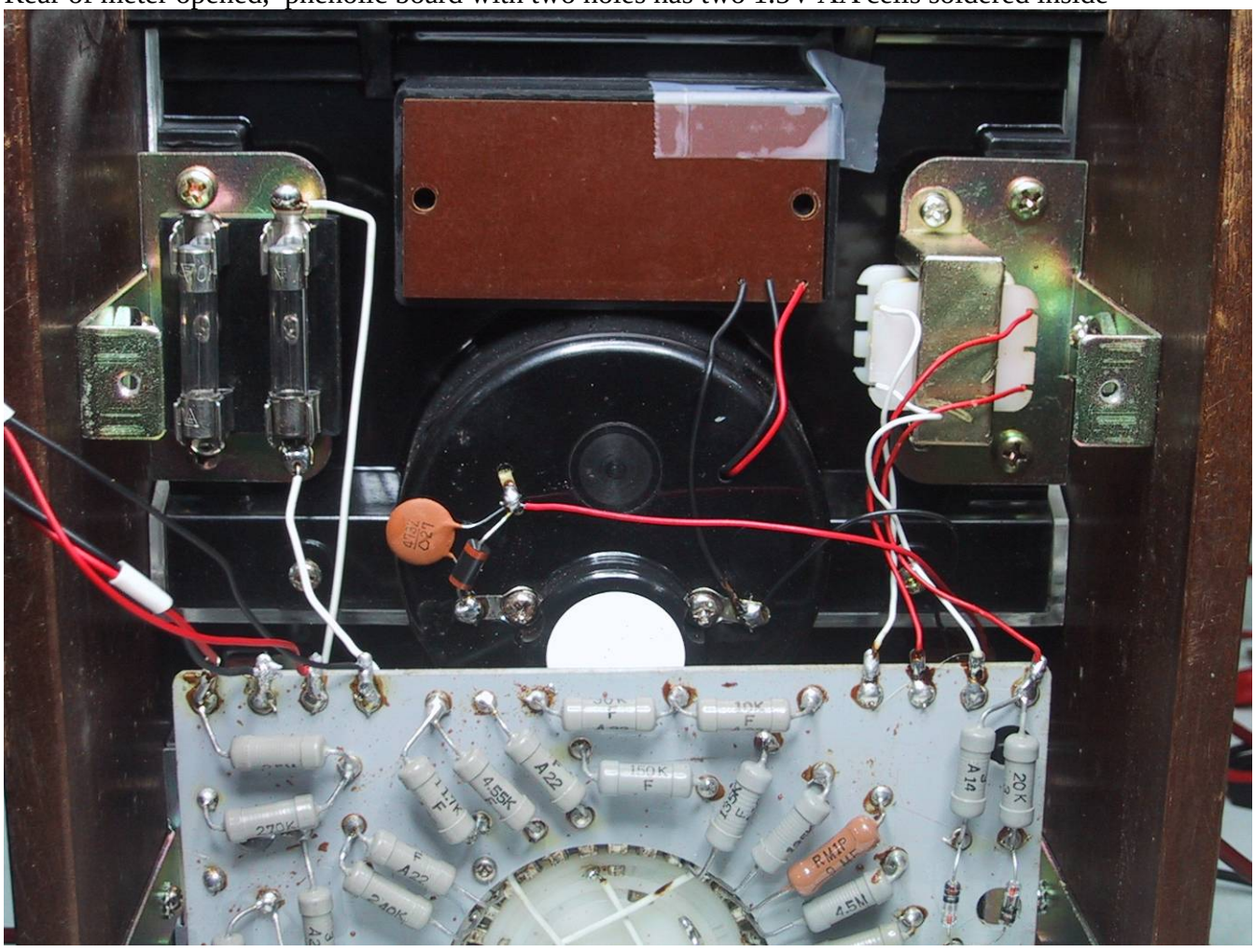
Original Circuit:

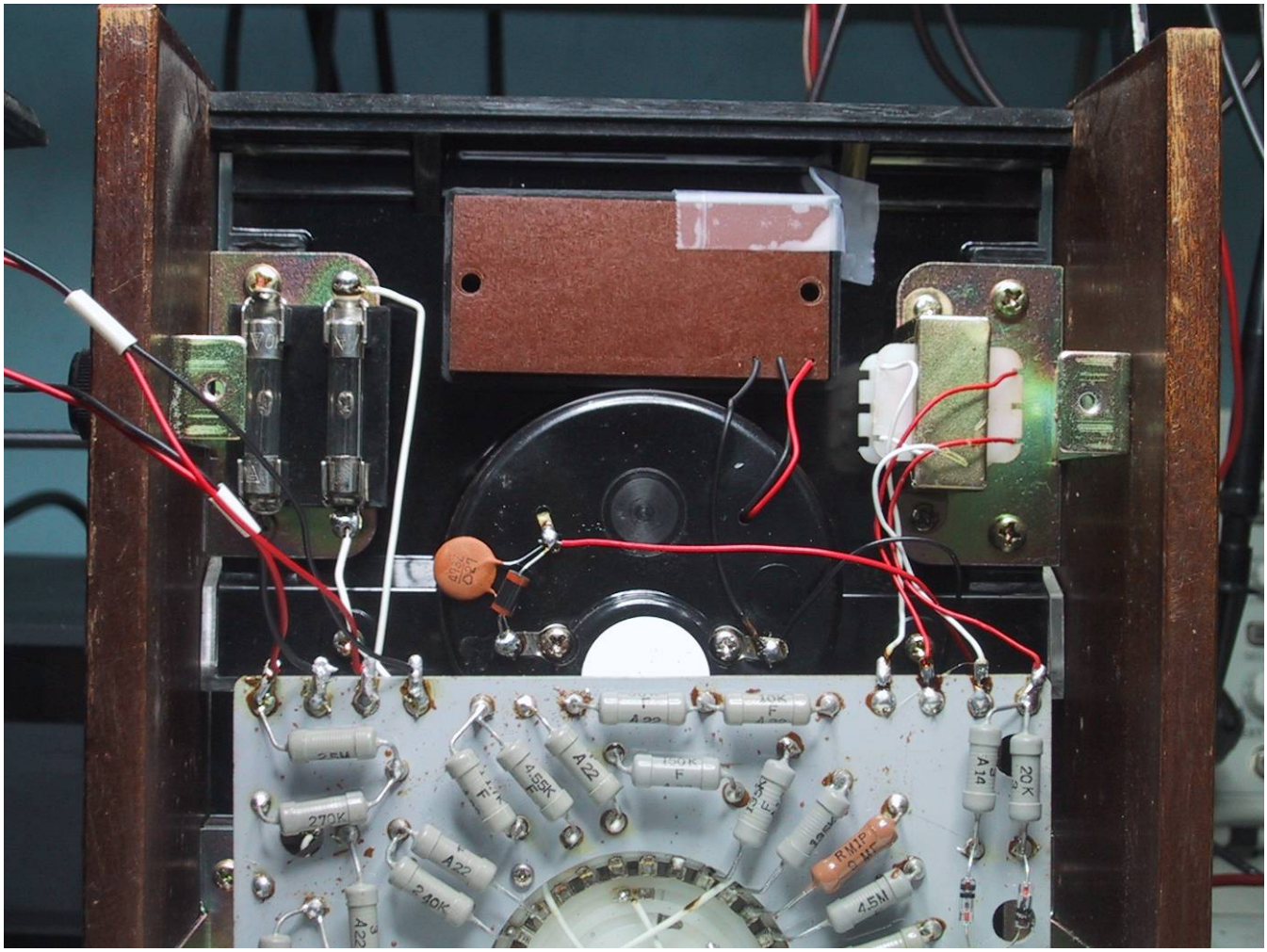
Instead of using a 2uA FSD meter as advertised
Sanwa used a 50uA meter driven by
a low standby current Op-Amp uA776
BT2 and BT4 were soldered permanently onto a PCB
PCB was mounted onto the meter housing
Meter malfunction when batteries exhausted
Due to undocumented presense of batteries
User has little idea about the cause of failure

Title: Sanwa N-501 meter Amplifier		
Size: A4	Document Number: MeterAmp.dsn	Rev: 1.0
Date: Friday, August 05, 2005	Sheet 1 of 1	

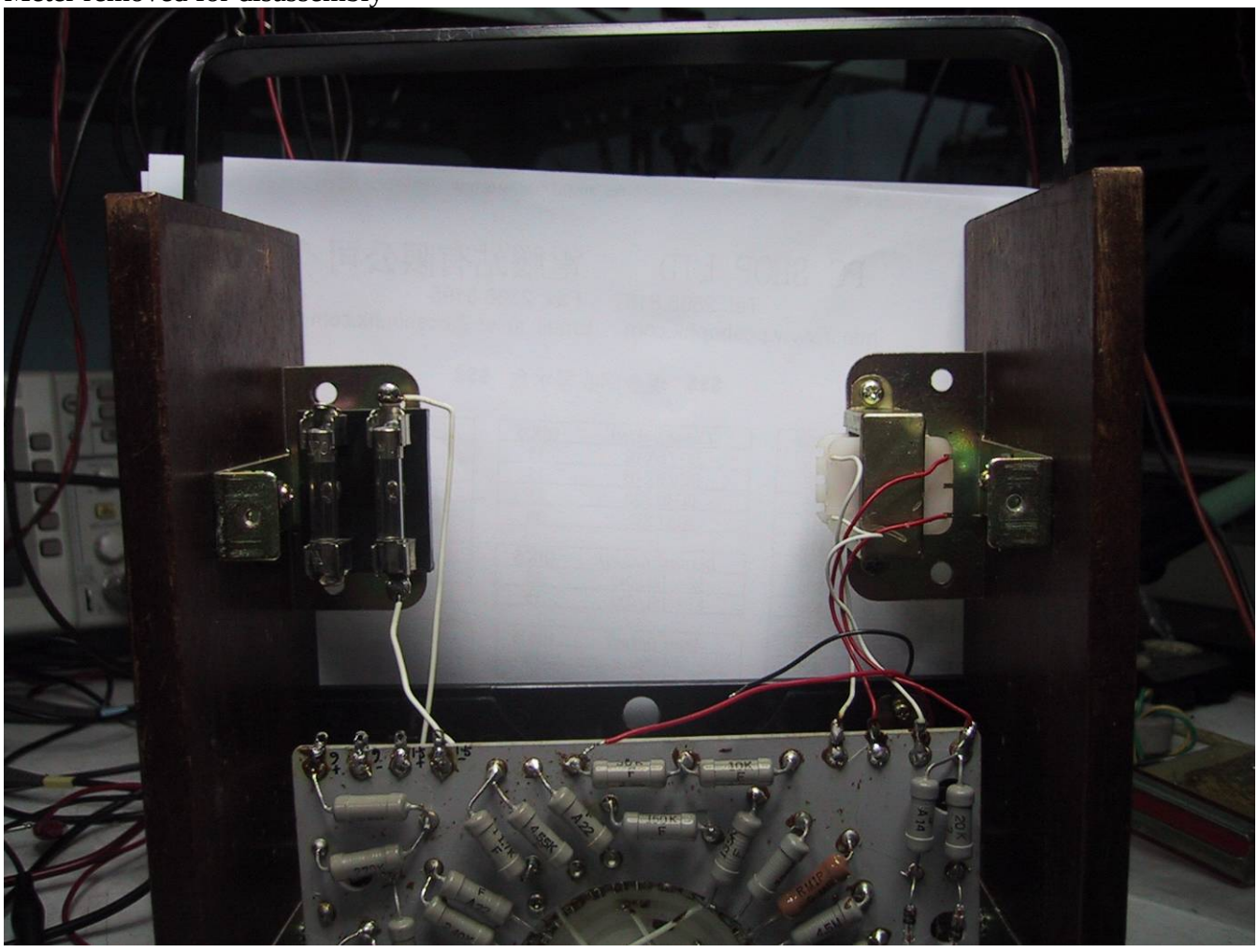


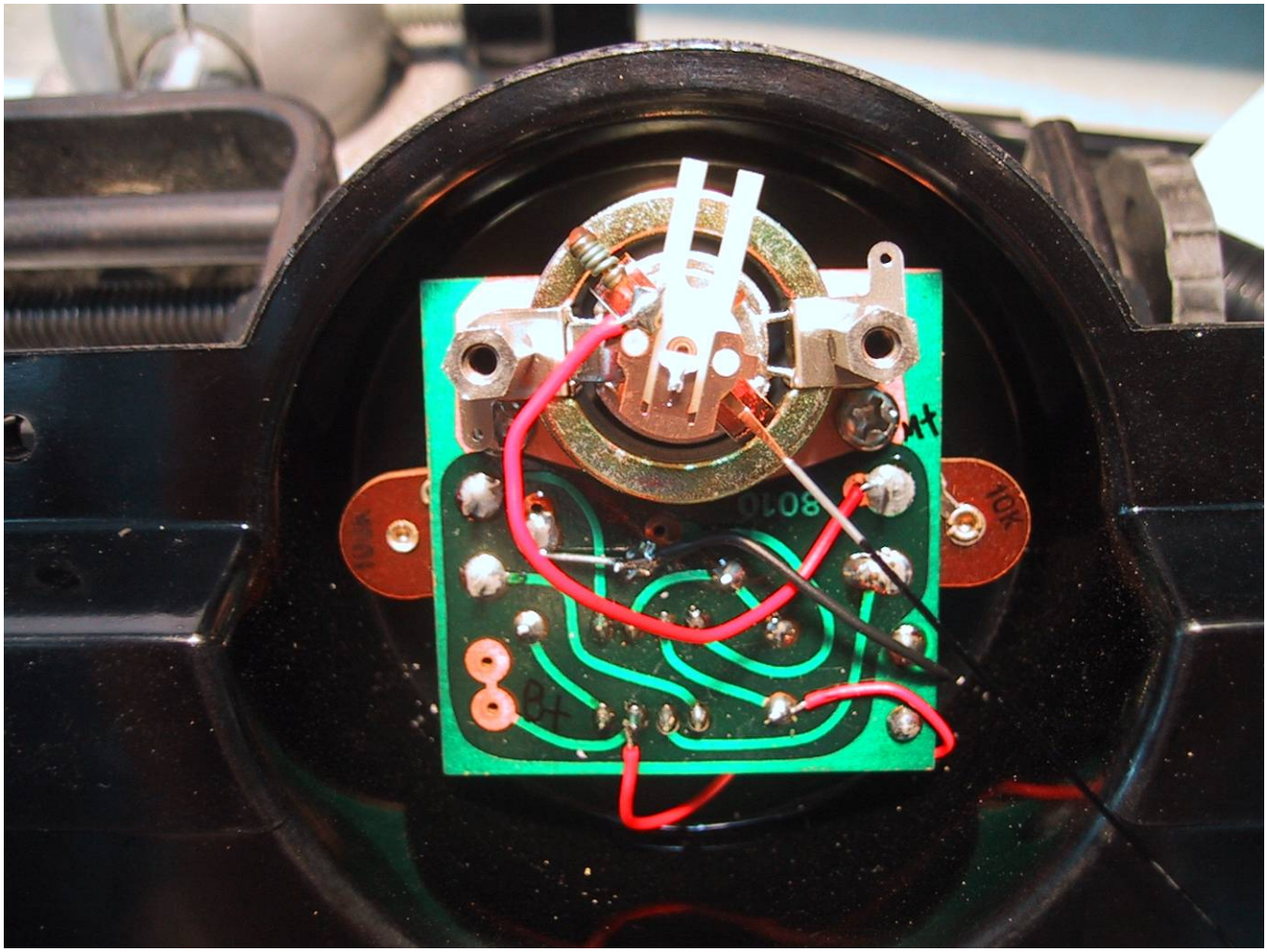
Rear of meter opened, phenolic board with two holes has two 1.5V AA cells soldered inside



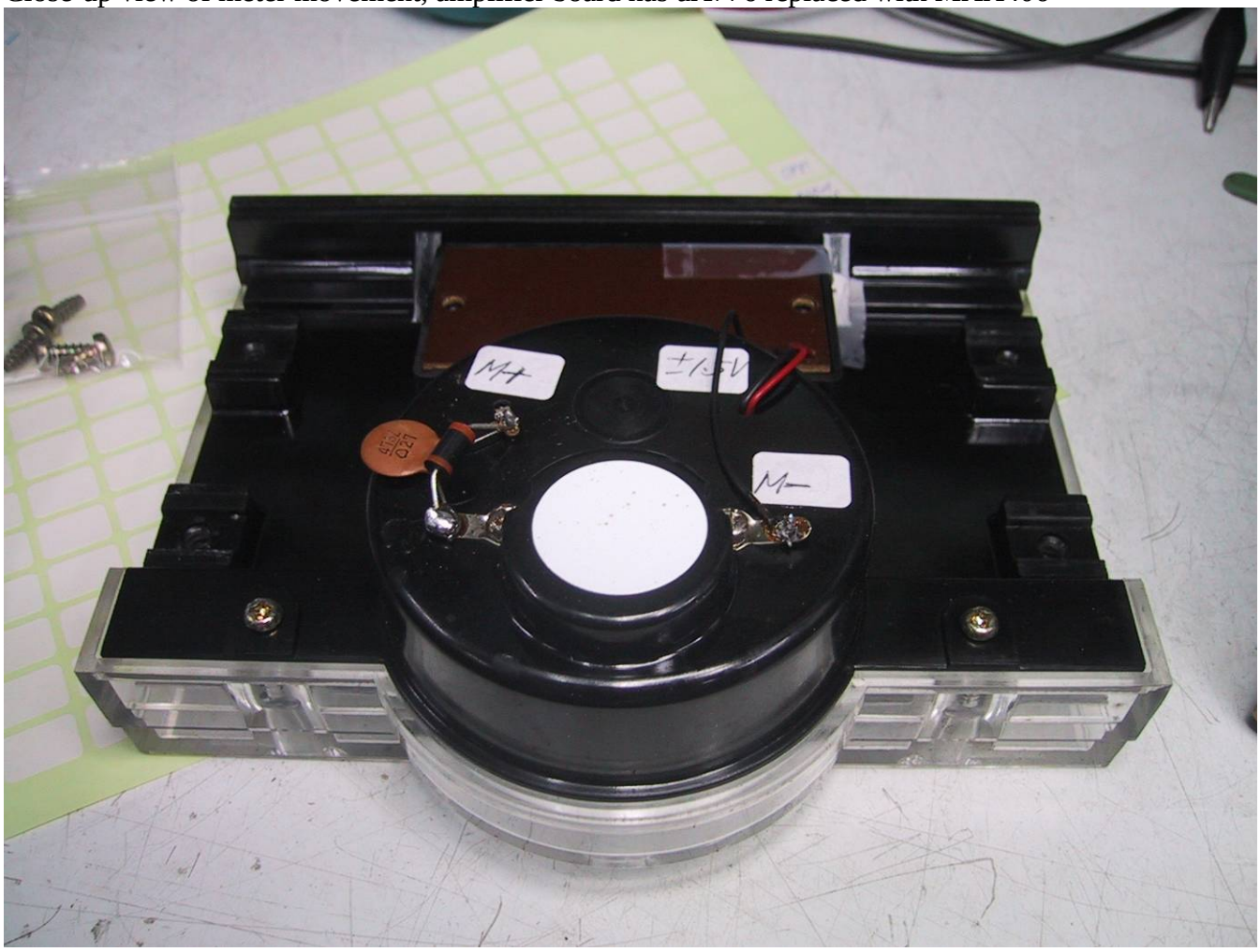


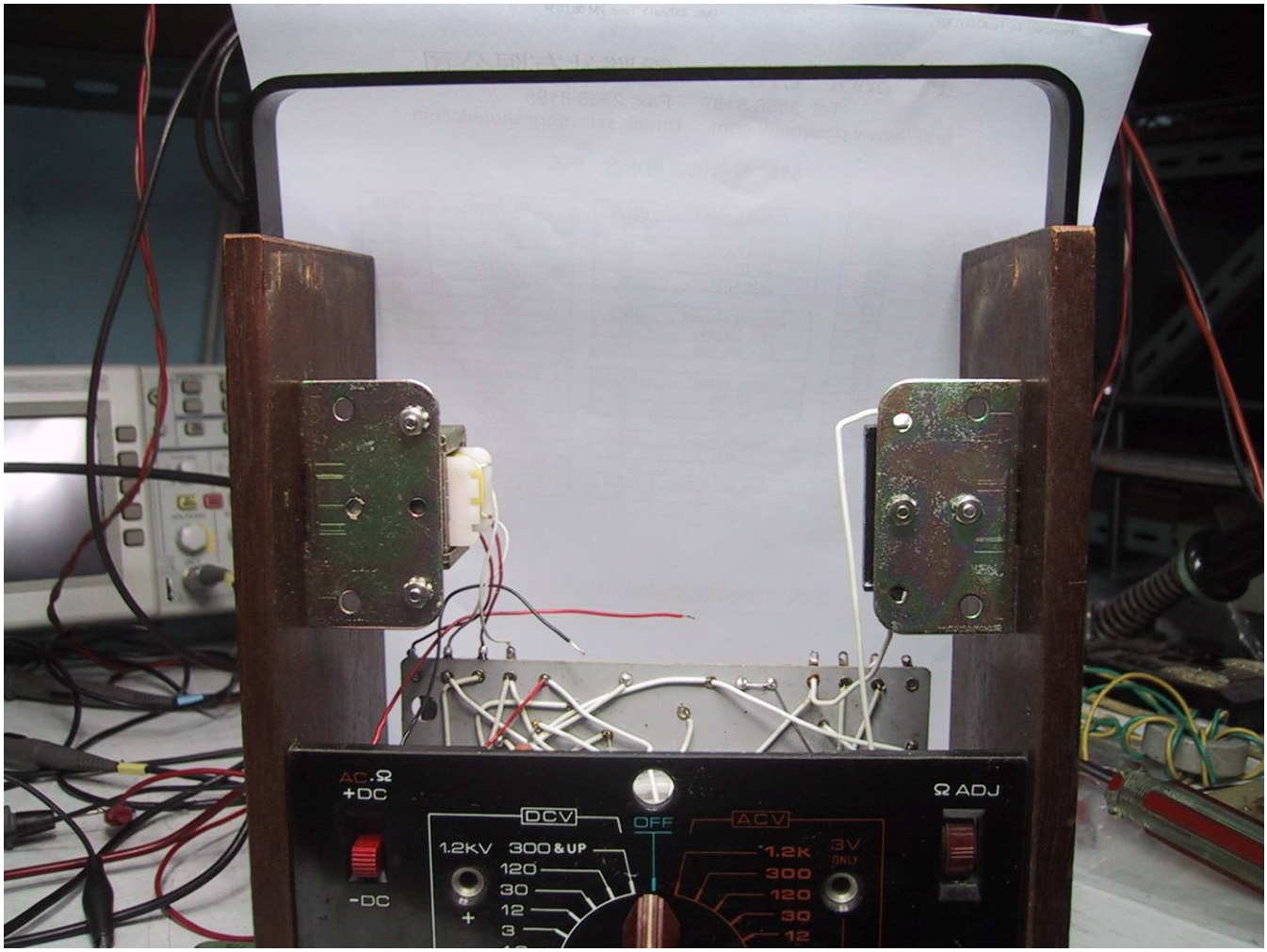
Meter removed for disassembly



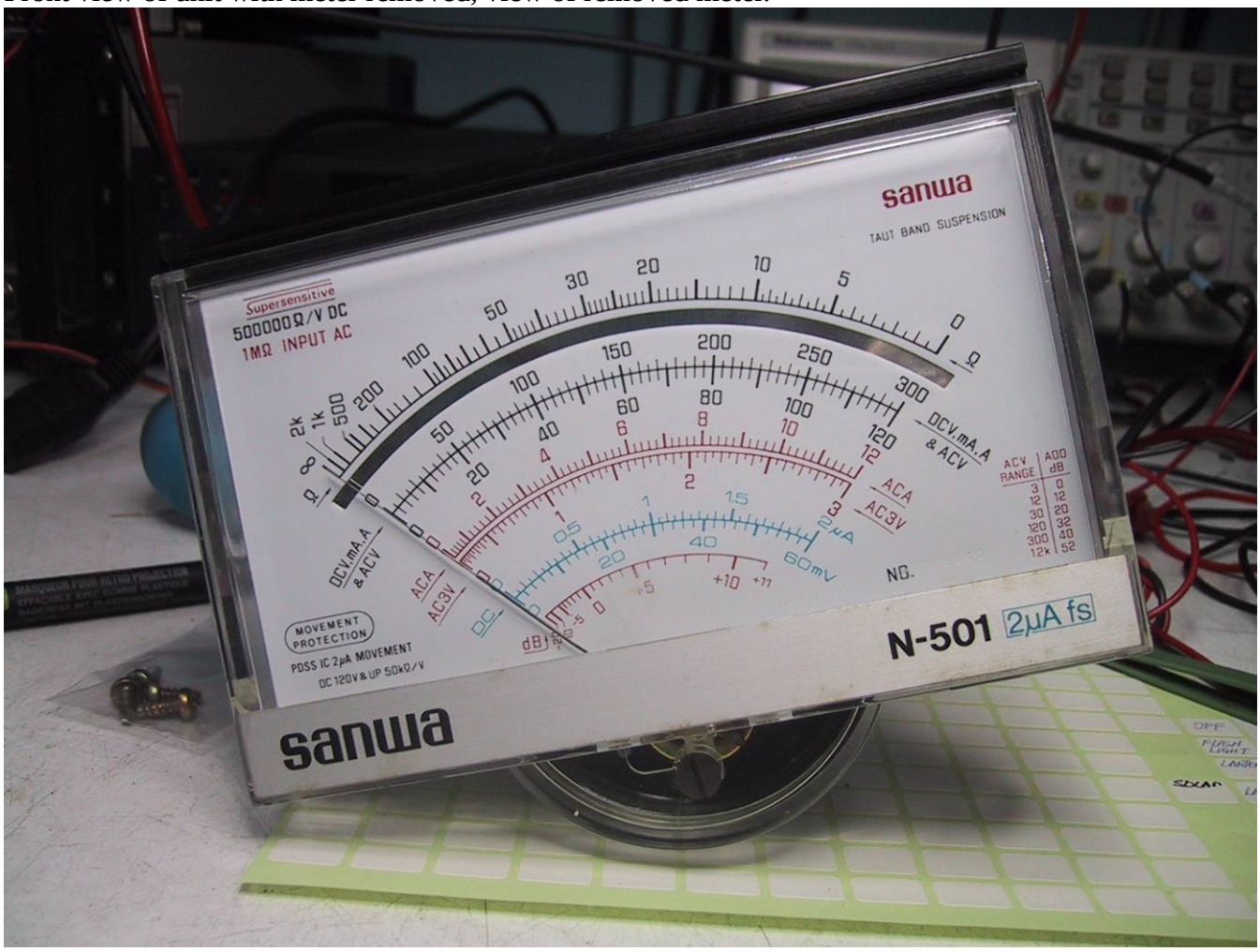


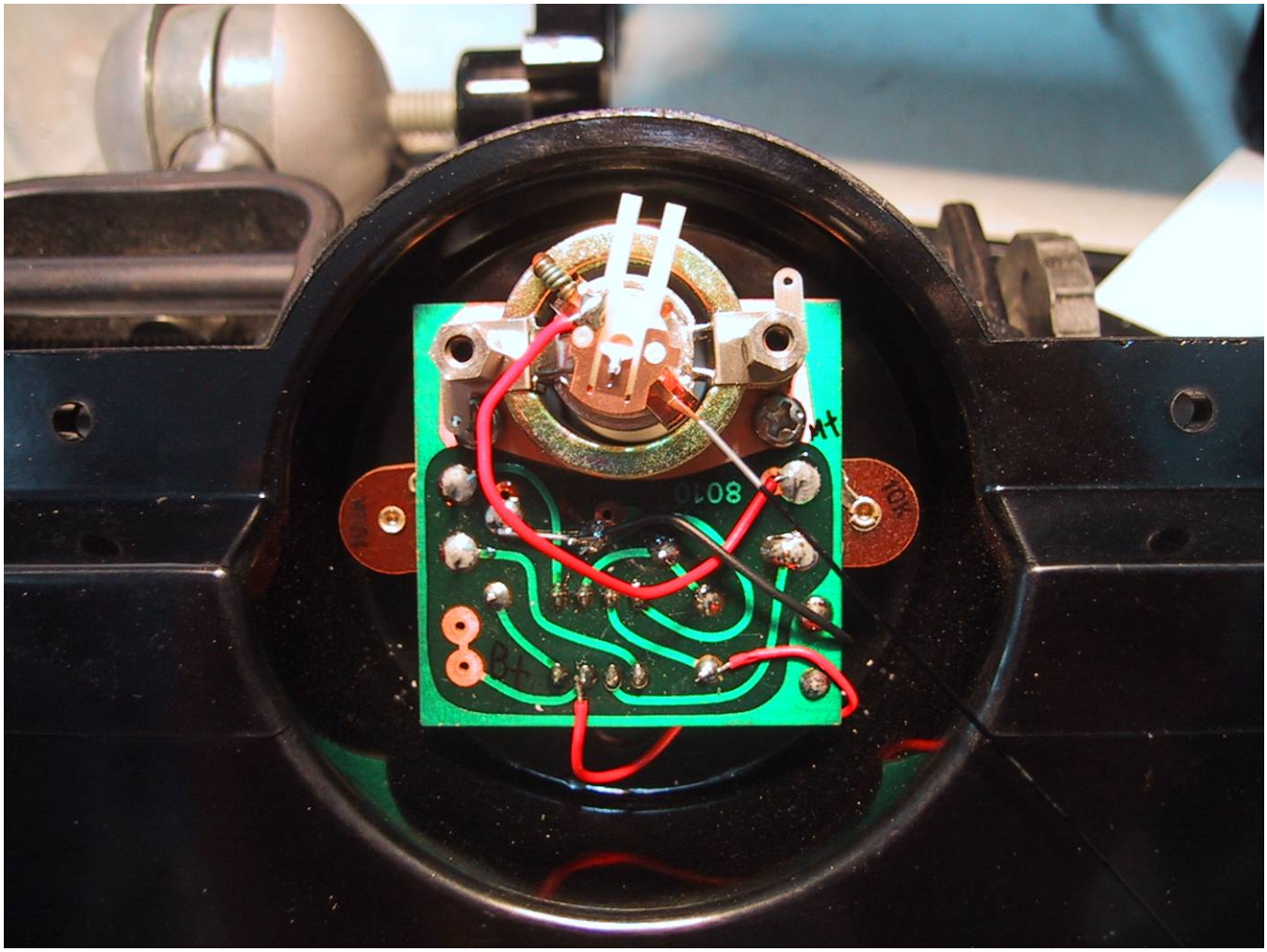
Close-up view of meter movement, amplifier board has uA776 replaced with MAX406





Front view of unit with meter removed, view of removed meter.





Another view of meter movement